A triggered seismic swarm below the city of Strasbourg, France on Nov 2019

Jean Schmittbuhl, Olivier Lengliné, Sophie Lambotte, Marc Grunberg, Cécile Doubre, Jérôme Vergne, François Cornet, and Frédéric Masson
Strasbourg University/CNRS, EOST/IPGS, UMS 830/UMR 7516, 5 rue René Descartes, 67000 Strasbourg, France
(jean.schmittbuhl@unistra.fr)

On Nov 12, 2019, a Ml3.1 earthquake was felt by the whole population of the city of Strasbourg, France. It was located by the BCSF-RéNaSS (EOST) in the northwestern part of the town (Robertsau area) at a depth of 5.5km. Its location in the vicinity of the deep geothermal wells (GEOVEN), the temporal correlation with the injection activity on site, the similarity of the depth between the bottom of the wells and the hypocenter of the event, the lack of local seismicity before the event occurrence, the known geological structures including crustal faults in the area, immediately questioned the possible triggering of the event by the deep geothermal activities despite the relatively large distance (4-5km). In order to assess the origin of the Ml3.1 event, we report here on the data analysis performed from the seismological monitoring of the local area using the catalog produced by BCSF-RéNaSS and the regional public seismic networks. The main result is that the event is part of a remote triggered swarm that was initiated at least six days before the main shock and lasted more than two months. Template matching has been applied and allowed for a significant improvement of the detections. Double-difference relocations evidenced a set of conjugated faults in the swarm area that extends over 800m. Focal mechanisms of the two main events are very consistent with the known regional fault in the area. The regional stress field in combination with the fault orientation and a Coulomb failure criterion shows that the swarm location is in an unstable domain if the cohesion of the fault is weak, particularly sensitive to stress perturbations.